Role of laparoscopy in acute abdomen

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Background
and aim Admission with an acute abdomen is one of the commonest reasons for emergency surgical admission. The aim of this study was to examine the role of laparoscopy in the management of such cases.
Patients and methods
A total of 35 patients who presented with acute abdomen in the period between January 2016 and March 2018 were enrolled. Their age was ranged between 10 and 55 years. After history taking and examination, baseline laboratory data were done. All patients were subjected to plain abdominal radiography, abdominal ultrasound, and computed tomography if needed. Under general anesthesia, laparoscopy was performed in all patients in a supine position.
Results
The mean age of enrolled patients was 33.51±10.54 years. Approximately two-thirds of them were females. Besides the abdominal pain, 80.0% patients had a fever, and more than one-half of them (54.3%) had vomiting. Based on an abdominal ultrasound, one-third of the cases had acute calculous cholecystitis. Approximately half (48.6%) of the cases had unremarkable findings and needed another test to reach a final diagnosis. Based on clinical, laboratory, and radiological data, we reached conclusion in up to 40% of the cases as acute appendicitis and 28.6% as acute cholecystitis, but we could not reach a diagnosis in approximately one-third of the cases. Only 5.7% could not be completed by laparoscopy and were converted to open surgery owing to bleeding. The majority (77.1%) of the cases had no postoperative complications.
Conclusion
Laparoscopy provided higher diagnostic accuracy and improved quality of life in cases of acute abdomen.

Keywords:
acute abdomen, acute calculous cholecystitis, diagnostic laparoscopy, perforated peptic ulcer

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Introduction

Acute complaints referable to the abdomen are common presentations in a surgical emergency. Acute abdomen is defined generally as an intra-abdominal process causing severe pain and often requiring surgical intervention. It is a condition that requires a fairly immediate judgment or decision as to the management [1].

Different strategies to assess these patients have been used, including observation, imaging methods, and early laparoscopy (EL). The rationale for the use of diagnostic laparoscopy (DL) in this setting is to prevent treatment delay, with the subsequent potential for poorer patient outcomes, and to avoid unnecessary laparotomy [1].

Emergency laparoscopy can be used for the diagnosis and/or management of a wide variety of acute abdomen. EL cholecystectomy in the course of acute cholecystitis decreases overall hospital stay and avoids increased complications, conversion to open procedures, and mortality [2].

Among the many randomized studies comparing laparoscopic appendectomy and open appendectomy, most cases were female patients of fertile age. The diagnostic advantages of laparoscopy in men and children are less clear owing to the relative ease of diagnosis in these subgroups [3]. Laparoscopic repair of perforated peptic ulcer (PPU) has advantages of less postoperative pain, shorter hospital stay, and earlier return to normal activities with low risk of mortality [4].

The use of EL in patients with undifferentiated acute abdominal pain is not recommended until now. So, clinical trials are required to assess the role of EL in this clinical situation [5]. Recently, the surgical practice has been revolutionized by the laparoscopic approach. The benefits of accelerated recovery, reduced morbidity,

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and mortality achieved through a less invasive approach are well established [6].

However, despite being broadly adopted in elective surgery, uptake of laparoscopy in the emergency setting has been more varied. Most published on this topic have been context specific with reference to individual pathologies, with the strongest evidence for procedures such as appendicitis, cholecystitis, and laparoscopy for nonspecific abdominal pain (NSAP) [7].

We designed this work to assess the role of laparoscopy in the diagnosis and treatment of undiagnosed acute abdominal pain based on baseline laboratory and radiological assessment.

Patients and methods

After obtaining approval from the local Ethical Committee of Faculty of Medicine at Assiut University, the current study was prospectively performed at the Department of General Surgery of Assiut University Hospitals. The study was performed in the period between January 2016 and March 2018. Informed consent was obtained from all patients or first degree relative.

Patients

A total of 35 patients with acute abdomen for more than 6 h with clinical evidence of surgical abdomen were enrolled, with an age range between 10 and 55 years. Any patient with uncontrolled hypercapnia, coagulopathies, severe abdominal distention, repeated abdominal surgery, heart failure or respiratory failure was excluded.

Preoperative assessment

Full history taking and physical evaluation were performed. As needed, fluid and electrolyte replacement was done. In cases of suspected peritonitis or intestinal obstruction, Ryle tube and Foley's catheter were inserted.

Laboratory investigations included complete blood picture, liver and kidney functions, and international randomized ratio. The pregnancy test was done in case of lower abdominal pain in patients in childbearing period. In case of suspected pancreatitis, serum amylase was ordered. Plain radiography abdomen (erect and supine) and sonography were done for all cases. In case of doubtful diagnosis, or suspicion of pancreatitis or mesenteric ischemia, computed tomography (CT) was done.

Operative assessment

Surgeries were done under general anesthesia in the supine position. Patients received preoperative prophylactic antibiotics, second to third generation cephalosporins. Informed consent was taken either from the patient or first degree relative.

With open (Hasson) technique and close technique by a nontraumatic trocar or veress needle, 10 mm metal trocars for the camera was inserted, usually periumbilical. Then a laparoscopic exploration of the abdomen was done. Additional trocars were inserted according to the pathology.

Nontraumatic intestinal graspers were used to deal with the intestine and omentum. Observation of any fluid and aspiration was done. Searching for the cause was based on probable diagnosis and intraoperative findings (nature of the fluid, aggregation of loops, or omental adhesions). If there was a satisfactory cause, exploration was completed and DL was considered successful. Dealing with the cause was through either complete laparoscopically, laparoscopic assisted via planned incision, or total conversion to open surgery.

If there was an unsatisfactory cause, a midline exploratory incision was done according to the most probable diagnosis. The peritoneal toilet was done by suction irrigation; 5 mm laparoscopic suction cannula was used. Irrigation was done by a large amount of normal saline. Drains were inserted according to pathology.

Statistical analysis

All the data were collected, correlated with each other, and analyzed using the Statistical Package of Social Science, version 20 (Statistical analysis was done using IBM SPSS statistics for windows, Version 20.0. Armonk, NY: IBM Corp). The quantitative data were presented in the form of mean and SD. The qualitative data were presented in the form of numbers and percentages. A c^2 test was used to compare qualitative variables. P value considered statistically significant when less than 0.05.

Results

Baseline data of the studied patients

The mean age of the enrolled patients was 33.51±10.54 years. Approximately two-thirds of them were females and from rural areas (62.9%) (Table 1). Moreover, 45.7% of them were housewives. Of those patients, 11.4% of them were smokers. Abdominal pain was presented in all patients. It was different in

Table 1 Baseline data of studied patients

	N=35
Age (year)	33.51±10.54
Sex	
Male	13 (37.1)
Female	22 (62.9)
Smoking	4 (11.4)
Abdominal pain	35 (100.0)
Fever	28 (80.0)
Vomiting	19 (54.3)
Tenderness in the right iliac fossa	15 (42.9)
Tenderness in the right upper abdomen	11 (31.4)
Tenderness all over the abdomen	5 (14.3)
Tenderness in the left iliac fossa	2 (5.7)
Postappendectomy right iliac fossa tenderness	1 (2.9)
Suprapubic tenderness	1 (2.9)

Data were expressed as *n* (%) and mean±SD.

Table 2 Laboratory and radiological data and provisional diagnosis of studied patients

	N=35
Leukocytes ($\times10^9$/l)	13.51±2.21
Hemoglobin (g/dl)	12.49±1.28
Platelets ($\times10^9$/l)	270.46±53.88
Neutrophils ($\times10^9$/l)	84.14±4.77
Urea (mg/dl)	46.54±10.20
Creatinine (mg/dl)	1.09±0.35
Amylase (u/l)	36.69±7.61
Lipase (u/l)	11.51±2.20
Aspartate transaminase (u/l)	43.66±7.42
Alanine transaminase (u/l)	46.40±7.61

Data were expressed as mean±SD.

characteristic and location, was localized or diffuse, and was associated with different reflex symptoms such as nausea and vomiting. Overall, 80.0% of them had a fever, where the underlying cause was mostly bacterial, and more than one-half of them (54.3%) had vomiting.

Most of the cases had acute onset, and this indicated to inflammatory causes. Only one case presented with sudden onset pain referring to the vascular event. All cases gave a progressive course, which was an indication for surgical emergencies. So, all cases needed intervention. According to the duration, nearly half of the cases had a short duration of up to 2 days (48.6%) and more than one-third (37.1%) had 3–4 days, and 14.3% had a duration of more than 5 days.

Overall, 42% of the cases had tenderness at the right iliac fossa. Approximately one-third had tenderness in upper the abdomen, whereas five patients had tenderness all over the abdomen. Two cases had tenderness in the left iliac fossa. Other baseline data are summarized in Table 1.

Table 3 Radiological data and provisional diagnosis of studied patients

	N=35	
Ultrasonographic findings		
Acute calculous cholecystitis	11	31.4
Mild free pelvic congestion	3	8.6
Complicated left ovarian cyst	1	2.9
Minimal free pelvic collection	1	2.9
Right subphrenic collection	1	2.9
Nonremarkable	17	48.6
Palin abdominal radiography		
Free findings	32	91.4
Free gas under diaphragm	1	2.9
Right pleural effusion	1	2.9
Shadow of intrauterine device	1	2.9
Provisional diagnosis		
Acute appendicitis	14	40.0
Acute calculous Cholecystitis	10	28.6
Abdominal pain for DL	11	31.4

Data expressed as *n* (%). DL, diagnostic laparoscopy.

Baseline laboratory of studied patients

All cases underwent routine investigations, such as CBC, liver function, and kidney function (Table 2). Another specific investigations for certain diagnoses such as a pregnancy test for females in childbearing period with lower abdominal pain, and amylase and lipase for cases with upper abdominal pain. We noticed elevation of leukocytes and neutrophils in most cases, which indicated inflammatory and bacterial causes. Regarding kidney function, almost all cases were normal, except one patient who presented with acute abdomen and impaired kidney function. Regarding liver enzymes, amylase and lipase were all within normal limits.

Radiological data and a provisional diagnosis of studied patients

Abdominal ultrasonography (US) is very important in the evaluation of acute abdomen, but it is operator dependent, where it is a dynamic examination, so an experienced doctor can give a good report (Table 3). We found that approximately one-third of the cases had acute calculous cholecystitis. Approximately half of the cases (48.6%) had unremarkable findings and needed another test to reach a final diagnosis.

One case had a right subphrenic abscess, one case had left complicated ovarian cyst, and three (8.6%) cases had a mild free pelvic collection. One case had a history of intrauterine device (IUD) application with missed thread, and abdominal US confirmed empty uterus.

A plain radiography was done for all patients. We found that 91.4% of patients were nonconclusive, and one case had free gas under diaphragm. One case

presented with right pleural effusion and raised copula of the diaphragm. Another case showed IUD shadow, and by comparing with US and history and examination, we reached a definite diagnosis as acute uterine perforation during application of IUD.

Based on clinical, laboratory, and radiological data, we reached conclusion in up to 40% of the cases as acute appendicitis and 28.6% as acute cholecystitis, but we could not reach a diagnosis in approximately one-third of the cases.

Operative, postoperative, and follow-up data of the studied patients

In up to 94.3% of the cases, surgery was completed by laparoscopy either as diagnosis or treatment (Table 4). Only 5.7% could not complete by laparoscopy and were converted to open owing to bleeding. The majority (77.1%) of cases had no postoperative complications. Four (11.4%) cases showed postoperative ileus, which was managed conservatively with nothing permouth (NPO), intravenous fluid, and Ryle till motility regained.

Table 4 Operative, postoperative, and follow-up data of the studied cases

	N=35	
Operative data		
Laparoscopy	33	94.3
Convert to open	2	5.7
Operative duration (min)		
<60	20	57.1
≥60	15	42.9
Postoperative complications		
No complication	27	77.1
Ileus	4	11.4
Port complication	3	8.6
Bleeding	1	2.9
Follow-up pain		
Mild	33	94.2
Moderate	1	2.9
Severe	1	2.9
Hospital stay (days)		
1 day	27	77.1
2 days or more	8	22.9
Return to normal life activity		
Within 1 week	22	64.7
More than 1 week	12	35.3

Data was expressed as *n* (%).

Port complication was noticed in three (8.6%) patients in the form of port site infection which passed conservatively. Bleeding occurred in one case with laparoscopic cholecystectomy with subsequent conversion to open.

In follow-up of our cases regarding postoperative pain, the majority (94.2%) experienced mild pain, and also, the majority (77.1%) of them had 1-day hospital stay. Regarding return to normal daily activity, we found that 64.7% returned to normal daily activity within 1 week and 35.3% returned to daily activity after 1 week. Other data are summarized in Table 4.

Relationship between hospital stay and the provisional diagnosis

We found that there is a significant relation between hospital stay and diagnosis. All cases of acute appendicitis spent 1 day (Table 5). More than one-half of the cases of abdominal pain for DL (54.5%) spent more than or equal to 2 days, whereas two cases of acute calculous cholecystitis spent more than or equal to 2 days.

Accuracy of provisional diagnosis in the diagnosis of acute appendicitis

We noticed that clinical diagnosis had sensitivity of 84.62%, specificity of 86.36%, and accuracy of 85.7% for the diagnosis of acute appendicitis based on the final diagnosis by laparoscopy (Table 6, Fig. 1).

Discussion

Ultimately when a patient with acute abdominal pain is referred to the surgeon, the surgeon may be in a dilemma, and even the latest investigations like CT

Table 6 Accuracy of provisional diagnosis in diagnosis of acute appendicitis

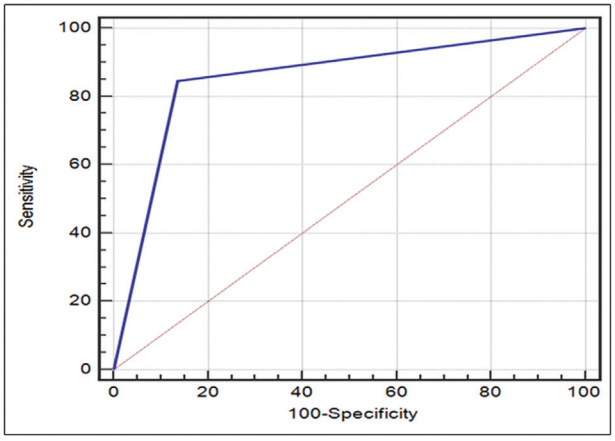
Indices	Value (%)
Sensitivity	84.62
Specificity	86.36
Positive predictive value	78.60
Negative predictive	90.50
Accuracy	85.71
Area under curve	0.85

Table 5 Relationship between hospital stay and the provisional diagnosis

Hospital stay	Diagnosis			*P* value
	Acute appendicitis (*N*=14)	Acute calculous cholecystitis (*n*=10)	Abdominal pain for DL (*n*=11)	
1 day	14 (100)	8 (80)	5 (45.5)	<0.001
2 days or more	0	2 (20)	6 (54.5)	

Data were expressed as frequency (percentage). *P* value was significant if <0.05. DL, diagnostic laparoscopy.

Figure 1



ROC for acute appendicitis by provisional diagnosis. ROC, receiver operating characteristic curve.

scan with contrast study may not help much. DL alone will be useful, and the use of laparoscopy is well established in the management of acute as well as chronic abdominal pain [8].

Golash and Willson [9] found that the definitive diagnosis was made in 90% of patients after DL. Laparoscopy changed the clinical diagnosis in 31.4% of cases. In our study, we reached a definitive diagnosis in 100%. Regarding preoperative diagnosis, Lockwood *et al.* [10] concluded that DL for acute right iliac fossa (RIF) pain in females was safe and associated with improved diagnostic rates over US.

Agrusa *et al.* [8] stated that NSAP represented 22–40% of acute abdomen cases. In our study, NSAP reached 31.4% of all cases. Garbarino and Shimi [11] noticed that routine laparoscopy reduced the negative appendectomy rate to 5%. Moreover, Shahzad [12] found that 31.3% of the suspected acute appendicitis cases had the pathology.

Majweski [13] stated that DL changed the treatment in 14% of cases. In our study, we avoided unnecessary appendectomy in ~6% of these cases. Regarding the diagnosis of specific pathologies, Luke *et al.* [14] found that US does not help in patients with suspected appendicitis.

Garbarino and Shimi [11] noticed the elevation of diagnostic accuracy of routine DL in acute appendicitis to more than 95%. Mirabella *et al.* [15] claimed that clinical diagnosis along with plain radiography has a sensitivity of 50–70% for the confirmation of pneumoperitoneum in cases of PPU.

Chen *et al.* [16] in a retrospective study of 14 patients with PPU reported a 100% reliability of a CT scan to determine a pneumoperitoneum, but only 36% in determining the perforation site. Smith *et al.* [17] showed an 86% accuracy of CT in specifying the size of the lesion, which increases to 90% by using. In our results, the diagnostic accuracy of clinical diagnosis plus plain radiography was only one case.

According to Babannavar *et al.* [18], US is the preferred initial modality in the investigation of right upper quadrant pain. It is more sensitive than CT in the diagnosis of acute cholecystitis. Moreover, Agresta and colleagues recommended laparoscopy for the treatment of established acute cholecystitis, not for a diagnosis. In our results, clinical examination plus US accomplished more sensitivity (75%), but less specificity (88%) and accuracy (79.3%). Already DL was perfect in these cases by 100% sensitivity, specificity, and accuracy [8].

Agresta and colleagues noted that DL is effective in the diagnosis and treatment of Hinchey class II b and III acute diverticulitis with abscess not amenable to drainage (IIb) or purulent diffuse peritonitis (III), whereas the conversion may be needed in class IV. They also stated that there was no advantage of DL over CT in the diagnosis of acute mesenteric ischemia. In our study, laparoscopic diagnosis of diverticulitis was difficult [8].

DL is useful for making a definitive clinical diagnosis whenever there is a diagnostic dilemma. Laparoscopy reveals either no abnormality or discovers a disease requiring no surgery for proper management, thus avoiding an unnecessary burden of nontherapeutic laparotomies [18].

Laparoscopy has become a routine procedure in the management of acute abdominal disease and can be considered both an excellent therapeutic and additional diagnostic tool in selected cases. Gonenc *et al.* [19] converted 7% of their laparoscopically diagnosed cases to open surgery for the sake of treatment. In our study, 94.3% of surgically positive cases were done laparoscopically. Overall, 5.7% were done completely open for diagnosis and treatment. Moreover, two cases were tried laparoscopically and converted to open.

Kucuk [20] claimed that of the 75 cases of laparoscopic appendectomy, the rate of conversion to open surgery was 1.3%, and they were complicated. Agresta and colleagues stated that conversion rate after Laparscopic appendectomy (LA) for total procedures was 3.6% and

after LA in complicated appendicitis was 4.6%. Regarding the treatment of acute appendicitis, all cases were done laparoscopically; however, one case of complicated appendicitis was converted to open surgery [8].

Navez and Navez [21] concluded that although laparoscopic cholecystectomy is currently considered as the standard treatment for acute cholecystitis, an open approach is still a valid option in more advanced disease. The conversion rate was 10%. Campanile *et al.* [22] stated that the incidence of conversion is 9.5% if surgery is performed within 2 days from the onset of symptoms and rises to 16.1% if surgery is done within 4 days. Our results revealed all our operations were done laparoscopically and within 2 days of admission. Conversion rate was 0%.

Regarding the treatment of PPU, Agresta *et al.* [8] stated that laparoscopy is a useful diagnostic tool, especially if a laparoscopic treatment is likely. Saverio *et al.* [23] recommend the laparoscopic approach for diagnostic purposes and also suggested laparoscopic repair of PPU in stable patients with PPU less than 5 mm in size. Our results in PPU (one case), the other case was done laparoscopically in which the perforation was 1 cm.

Mbadiwe *et al.* [24] concluded that the laparoscopic approach is associated with lower complication rates compared with the open approach for the surgical treatment of diverticulitis with primary anastomosis.

Regarding the outcome measures for cases of the acute abdomen as a whole, Agresta *et al.* [25] included 1272 patients admitted with acute abdomen who were approached laparoscopically. In comparison with open surgery, there was a significant reduction of total complication in laparoscopic treatment than open surgery (1.9 vs. 13%); the percent of redo surgery was 1.3%, and mean hospital stay was 4.5 versus 6.5 days.

Our results showed that regarding perioperative complications, collectively, there was one case of bleeding, four cases of postoperative ileus, and three cases of port site complication. In the laparoscopic group, there was no mortality, no anesthetic complications, and no case of intestinal injury. The mean length of hospital stay for laparoscopic was 2.6 versus 5.3 days for open. Regarding laparoscopic appendectomy, Thereaux *et al.* [26] found that 7.1% of patients experienced intra-abdominal abscess; seven of these cases were treated conservatively. The mean length of hospital stay was 6.9±5.

Our outcome in LA for noncomplicated appendicitis shows no mortality, no anesthetic complications, and one (2.5%) case of iatrogenic intestinal injury. Mean length of stay (LOS) was 1 versus 1.7 days in open cases. However, for complicated appendicitis, the results revealed no mortality, no anesthetic complications, and no cases of wound infection. Mean hospital stay was 4 versus 5.7 days in open cases.

For acute cholecystitis, Navez *et al.* [27] found that 3.5% of the cases presented biliary complications in the EL group and 4.5% had other local complications. Our result showed no mortality, no anesthetic complications, no cases of intraoperative bleeding, and no cases of port site infection. Mean stay was 1.5 versus 4.7 days in open cases.

Regarding PPU, Bertleff and Lange [28] found that for laparoscopic treatment there was less total mortality (2.5 vs. 5.8% in open surgery), total morbidity (22 vs. 36% in open surgery), and LOS (6 vs. 6.5%). Our result showed no mortality, no anesthetic complications, and only one case of postoperative intra-abdominal collection (2.5%), which was treated by US-guided drainage and covering antibiotics. The mean LOS was 6.5 days.

Conclusion

EL is valuable in the management of NSAP. It provides a significantly higher diagnostic accuracy and a better improvement in the quality of life than the more traditional approach of active observation.

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Conflicts of interest

There are no conflicts of interest.

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